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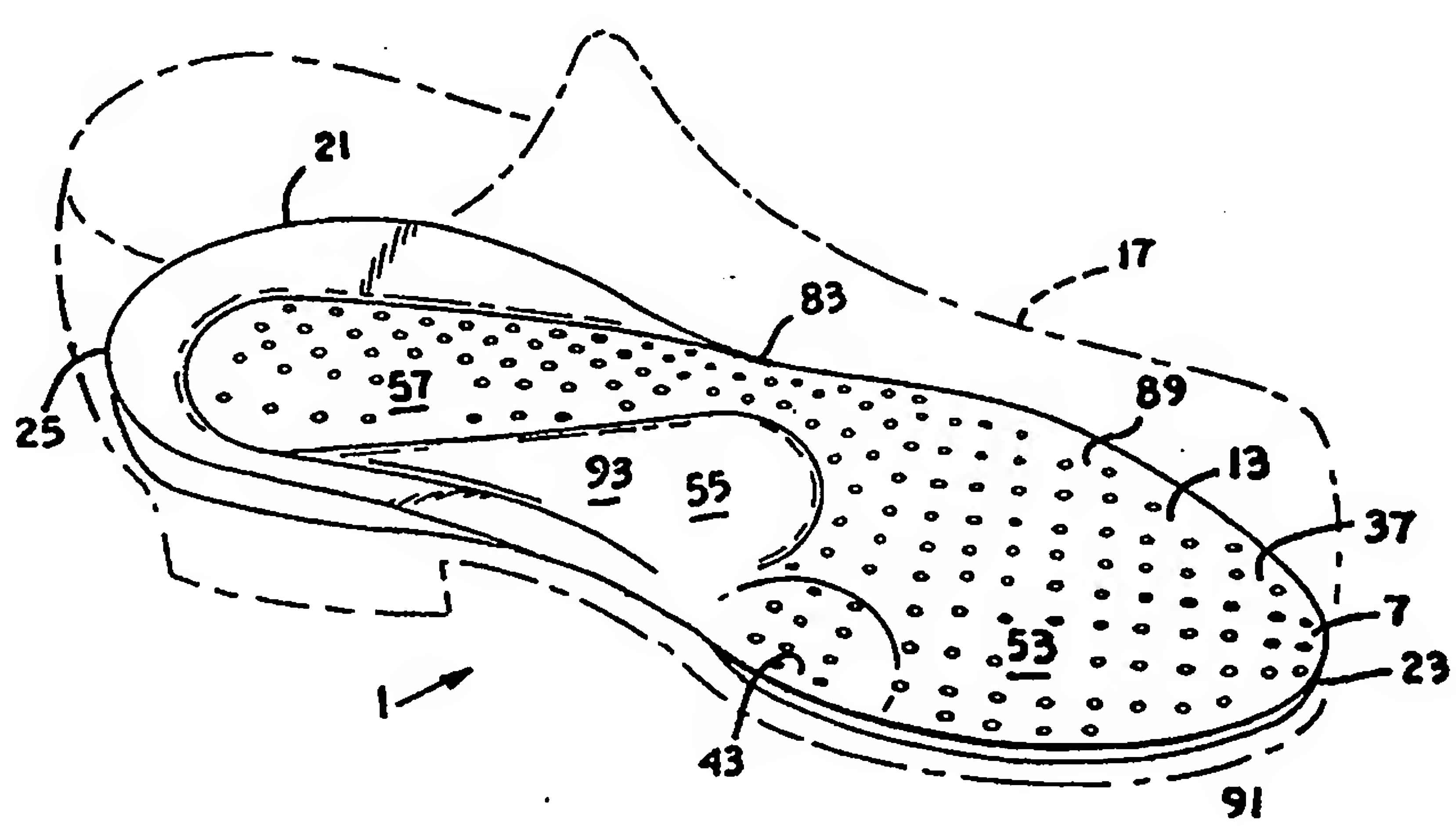

(57) Abstract

An insole insert (1) comprises a unitary body member (7), constructed of material having a selected material compression resistance and having a bottom portion (37) with a toe portion (53), a heel portion (45), an arch portion (47), and a metatarsal support portion (55). The metatarsal support portion (55) extends rearwardly from the toe portion (53) alongside the arch portion (47) and forms a boundary (73) beginning beneath the juncture between the user's first and second metatarsal shafts (M1, M2), arcuately passing beneath the user's first through fourth metatarsal necks (N1, N2, N3, N4), and passing beneath the juncture between the fourth and fifth metatarsal shafts (M4, M5) and the juncture between the cuboid and the lateral cuneiform and navicular bones. A relief is generally formed along the boundary. Perforations (91) in the body member provide at least one perforation-modified portion (89), having a selected effective compression resistance with a magnitude less than the magnitude of the material compression resistance, and a non-perforation-modified portion (93) not having the perforations.

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INSOLE INSERT HAVING PERFORATION-MODIFIED RESILIENCY

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to footwear and, more specifically without limitation, to an insole insert for footwear.

2. Description of the Related Art

Although children are usually born with normal arches, as a child begins to walk and body weight is applied to his feet as they bear against a supporting surface, his foot structure necessarily reacts by tending to flatten out under the weight-generated forces applied to the soles of his feet. If the child were walking only on natural supporting surfaces, *e.g.*, the ground, the normal age for the child to be able to stand without the need of external support for his feet is generally considered to be approximately eight years of age. For purposes of improved appearance, convenience, endurance, etc., however, man-made products are generally applied to those supporting surfaces. Unfortunately, such "improved" surfaces tend to be detrimental to the human musculoskeletal structures, especially during the developmental stages when the child's foot structure is "soft" and incompletely formed. Due to such negative environmental influences on the human foot

structure, shoes which provide proper support and shock attenuation should be worn for protection and prevention of structural injury.

As disclosed in U.S. Patent No. 4,272,899, issued June 16, 1981 to Jeffrey S. Brooks, the disclosures and teachings of which are incorporated herein by reference, a contoured insole structure may be provided in children's shoes to reduce abnormal stress from the heel to the metatarsals by properly supporting and stabilizing the feet during development thereof. By so doing, the associated stresses placed upon the medial column of the foot is also reduced, distributing the body weight more evenly on the sole of the foot.

More specifically, when walking or running, the lateral (outside) portion of the heel is generally the first part of the foot to strike the ground, with the foot then pivoting on the heel to bring the lateral part of the forefoot into a position whereat it bears against an underlying surface. At that point,the foot resides in a supinated (inclined upwardly from the lateral to the medial side of the foot). The foot then pronates until all of the metatarsal heads are in the horizontal plane (flat to the supporting surface). The bone structural alignment should be firmly supported when the foot assumes such neutral position in order to prevent the ligaments, muscles and tendons of the foot from becoming over-stressed.

Various skeletal characteristics of the feet that are pertinent to proper foot support include the first, second, third, fourth and fifth metatarsal heads, indicated in phantom at M1 through M5 in Fig. 1; first, second, third, fourth and fifth metatarsal necks associated with the respective metatarsal heads M1-M5, indicated

in phantom at N1 through N5; first, second, third, fourth and fifth proximal phalanges spaced distally from the respective metatarsal heads M1-M5, indicated in phantom at P1 through P5; and first, second, third, fourth and fifth metatarsal phalangeal joints spaced between the respective metatarsal heads M1-M5 and proximal phalanges P1-P5, indicated at J1 through J5 in Fig. 1. Further, various muscles and tendons characteristically interact to stabilize the foot during the sequence of progressive movements normally experienced in a walking or running gait in preparation for movement from the neutral position to a propulsive phase of the gait cycle, sometimes referred to as "toe-off" or "push-off".

Flexion of the first metatarsal phalangeal joint (i.e., the great toe joint) is normally approximately fifteen degrees to the associated metatarsal in a dorsiflex position when standing, and increases to between sixty-five and ninety degrees, depending on the available motion and the activity required by the joint just prior to lifting off the underlying supporting surface. The relationship among the foot bones is such that the first metatarsal phalangeal joint and the two small bones there beneath, the tibial sesamoid and the fibular sesamoid, should be displaced downwardly ("plantarflex") in order for the toe to function appropriately.

Thus, the progressive phases of gait are heel strike, when the heel hits the ground; midstance, when stability of the arch is an essential necessity; and propulsive phase, as the heel lifts off the ground and the body weight shifts onto the ball of the foot. During the transition from the neutral position through toe-off, it is preferable

that the second and third metatarsals be firmly supported, and that the first metatarsal head plantarflex (move downward) relative the second and third metatarsal heads. The toes also should generally be firmly supported during toe-off so that they remain straight, and thus stronger, promoting a "pillar effect" by the phalanges.

To provide additional insight into some of the mechanisms of the human feet, it is known that the lower limbs of the human embryo begin to rotate internally ninety degrees from an external position at the pelvic girdle at approximately the eighth week of fetal development. At the twelfth week of development, the feet begin to dorsiflex, and around the sixteenth week of development, the completely inverted feet begin to evert, all of which are part of the complex preparation of the lower extremity for upright, bi-pedal weight-bearing posture and locomotion. A child's feet and legs have sometimes been described as a loose bag of bones and cartilage floating in a mass of soft tissue until about age six. As a result, foot posture is a rapidly changing proposition for children under the age of six years. The true structure of a child's foot is not developed until approximately seven or eight years of age when development of the sustentaculum tali is generally complete. Further, eighty to ninety percent of the child's adult foot size is developed by the age of ten, with complete development occurring by approximately age 14-16 years in human females and age 15-17 years in human males.

When infants begin to bear weight, their feet begin to pronate excessively because their feet are not yet ready, without deformation, to be placed on an

unnatural surface, such as a hard flat surface. As a result, if uncorrected, repeated weight-generated forces may cause these early weight-bearing feet to permanently deform (excessive pronation). Thus, such early-age, weight-bearing feet should preferably be maintained in proper postural alignment by providing a more natural environment therefor, such as a better supporting interface between the feet and the underlying supporting surfaces, thereby allowing the feet to develop as normally as possible during their postnatal development.

Therefore, as soon as the child begins to bear weight on his feet, usually around six to seven months of age, treatment to neutralize excessive pronation should be instituted. The user's feet should be placed in their individually most efficient position to function properly and to reduce excessive strain not only on the feet but also on the lower body structure supported by the feet. In an ideal foot posture situation for minimal stress, the position in which the feet as weight-bearing organs would normally realize greatest efficiency (including an optimal ratio of supination and pronation) is one in which the subtalar joint is approximately forty-two degrees from the transverse plane, approximately sixteen degrees from the saggital plane, and approximately forty-eight degrees from the frontal plane, sometimes referred to as the neutral position hereinbefore mentioned. In the neutral position, the leg and calcaneus are perpendicular to the weight bearing surface, and the knee joint, ankle joint and forefoot, including the plane of the metatarsal heads, are substantially parallel to the subtalar joint and to the walking surface.

A fully developed human foot can generally be described as having one of three basic types: normal, low arch ("flat foot"), or high arch. From an anatomical standpoint, normal and flat feet are capable of being functionally controlled by the same basic shoe control mechanism, while a high-arch foot is structurally different and may require a different supporting environment. For example, the amount of adduction ("pigeon-toedness") of the front part of a normal or flat foot in relation to the heel area of the foot is typically slight, while the amount of adduction in a high-arch foot is generally much greater. Further, the movement of a normal or flat foot during running is also substantially different from that of a high-arch foot. If proper support and stabilization is not properly implemented during their early formative development, fully developed feet may be more susceptible to, and be more prone to suffer from, various maladies, including the following:

(a) tearing of the plantar fascia tissues which connect the heel to the ball of the foot and support the arch of the foot, sometimes referred to as "plantar fascial tears" or "plantar fasciitis", which generally arise from stressful upward pulls on the calcaneus ("heel bone") and strain of the intrinsic or interior foot muscles, and is generally realized as heel pain;

(b) excessive stress between adjacent metatarsals, sometimes referred to as "metatarsal stress fractures", generally arising from improper support of the talonavicular joint ("arch") and instability of the first ray ("great toe joint");

(c) irritation of the tissue associated with a small bone beneath the great toe joint, sometimes referred to as "tibial sesamoiditis", generally arising from inappropriate support of the talonavicular joint and/or inappropriate weight distribution between the various metatarsal phalangeal joints;

(d) excessive bony growth on the top of the foot, sometimes referred to as "saddle joint deformity", generally arising from improper movement of the first metatarsal and realized in the form of degenerative arthritis;

(e) inflammation and/or separation of tissue from the tibia, sometimes referred to as "shin splint", generally arising from improper articulation of the talonavicular joint between the ankle bone and the key supporting bone of the foot and generally realized as fatigue of the muscles in the front and back of the leg; and

(f) bruising in the bottom center of the heel generally arising from disproportionally greater weight-generated forces applied thereto.

Such maladies should be given due consideration, both in youth and in adults, as the human foot may start to breakdown as a result of degenerative disease by the age of thirty-five years.

In view of the foregoing, it should be obvious that certain parts of the feet are generally subjected to higher stresses during standing, running and walking, and that other parts of the feet require different degrees of support for maximum biomechanical efficiency, particularly since high impact forces to the foot are

generally transferred to other skeletal structures, such as the shins, knees, and lower back region.

Control of the user's foot must begin in the heel and proceed to the arch, including providing stability of the forefoot in order for the foot to function properly through the normal phases of gait. Various devices have been developed in attempts to provide needed support and stabilization for a user's feet. A frequent problem with most of such devices, however, is getting the devices to not only properly fit the user's feet but, in the case of insole inserts, to also fit the user's shoes while properly supporting and stabilizing the user's feet.

Thus, what is needed is a device, when placed into footwear, provides an appropriate amount of support and shock attenuation for different regions of the foot to thereby provide a proper environment that promotes a balanced foot position for healthy postural and skeletal structural development, thus allowing the parts of the foot to function in a way which provides maximum efficiency, to prepare the body for stresses normally subjected thereto, and to protect those parts of the foot which are subjected to high impact forces.

SUMMARY OF THE INVENTION

An improved insole insert for a user's footwear comprising a unitary body member having a bottom portion, a heel portion, an arch portion, and a metatarsal support portion. The body member, constructed of material having a selected

material compression resistance, includes a toe edge, a heel edge, a lateral side edge, and a medial side edge. The bottom portion includes a toe portion extending rearwardly from the toe edge to terminate generally distally from the second and third metatarsal phalangeal joints of the user's foot. The heel portion, which is formed along the heel edge, the lateral side edge, and the medial side edge of the body member; includes a lateral portion extending forwardly to a foremost end thereof that is spaced just rearwardly of the user's fifth metatarsal phalangeal joint.

The arch portion is formed along the medial side edge and extends forwardly from the heel portion to a foremost end thereof. The metatarsal support portion extends rearwardly from the toe portion alongside the arch portion and forms a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's first through fourth metatarsal necks, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones of the user's foot. A relief is generally formed along the boundary.

The insole insert also includes a concave depression area formed in the body member. The depression area is spaced generally beneath a first metatarsal phalangeal joint of the user such that the depression area is spaced just distally of the foremost end of the arch portion.

Perforations are selectively formed in the body member to provide the body member with one or more perforation-modified portions, each having a selected

effective compression resistance with a magnitude that is less than the magnitude of said material compression resistance, and a non-perforation-modified portion not having the perforations. The perforation-modified portion or portions may include the depression area of the heel, the depression area of the first metatarsal head, the depression area of the fifth metatarsal head, shaft and base, the toe portion, the bottom portion spaced between the arch portion, the heel portion, the metatarsal support portion, and cuboid portions of the surrounding body member. The non-perforation-modified portion, the supporting and controlling portions of the insole insert structure, may include the metatarsal neck support portion, the heel portion, the perimeter of the heel portion and the arch portion.

The depression area and the body member, including the heel portion and the arch portion, are configured to cooperatively redistribute weight-generated forces operatively bearing against the sole of the user's foot such that greater weight-generated forces normally bearing against certain regions of the sole of the user's foot are substantially reduced and redistributed toward other regions of the sole of the user's foot during mid-stance and propulsive phases of the user's gait.

PRINCIPAL OBJECTS AND ADVANTAGES OF THE INVENTION

The principal objects and advantages of the present invention include: providing a device for insertion into existing footwear; providing such a device that is tailored to the biomechanical operation of the wearer's foot; providing such a device for properly supporting and cushioning various regions of the wearer's foot;

providing such a device that includes a perforation-modified portion having perforations configured to provide the perforation-modified portion with an effective pressure resistance with magnitude that is reduced from the magnitude of the inherent pressure resistance of the material from which the device is constructed; providing such a device wherein components thereof are configured to cooperatively substantially reduce the magnitude of greater weight-generated forces normally bearing against certain regions of the sole of the user's foot and to redistribute those forces to other regions of the sole of the user's foot; and generally providing such a device that is efficient in operation, reliable in performance, and is particularly well adapted for the proposed usage thereof.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, which constitute a part of this specification and wherein are set forth exemplary embodiments of the present invention to illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic illustration, showing a top plan view of an insole of a left shoe and illustrating the approximate position of the metatarsal and related bone structure of a user's left foot in relation thereto.

Fig. 2 is a perspective view of an insole insert having perforation-modified resiliency for a left foot showing a shoe associated therewith in phantom, according to the present invention.

Fig. 3 is a side elevational view of the insole insert having perforation-modified resiliency.

Fig. 4 is an enlarged cross-sectional view ot the insole insert having perforation-modified resiliency, taken along line 4-4 of Fig. 3.

Fig. 5 is a further enlarged and fragmentary cross-sectional view, showing the insole insert having perforation-modified resiliency in an unloaded stated.

Fig. 6 is a further enlarged and fragmentary cross-sectional view, showing the insole insert having perforation-modified resiliency in a loaded state.

Fig. 7 is an enlarged top plan view of the insole insert having perforation-modified resiliency.

Figs. 7a - 7i are enlarged cross-sectional views of the insole insert having perforation-modified resiliency, taken respectively along lines a-a through i-i of Fig. 7, according to the present invention.

Fig. 8 is a schematic illustration, showing a top plan view of an insole of a left shoe with a variation of the insole insert of Fig. 1 shown in phantom, according to the present invention.

Fig. 9 is an enlarged top plan view of the insole insert having perforation-modified resiliency of a right shoe, similar to Fig.7 but also showing the variation of Fig. 8.

Figs. 9a - 9f are enlarged cross-sectional views of the insole insert having perforation-modified resiliency of a right shoe of the variation of Fig. 8, taken respectively along lines a-a through f-f of Fig. 9.

Fig. 10 is an enlarged, partially cross-sectional view of the insole insert having perforation-modified resiliency of a left shoe of the variation of Fig. 8.

Fig. 11 is an enlarged, partially cross-sectional view of the insole insert having perforation-modified resiliency of a left shoe of the variation of Fig. 8, according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

The reference numeral 1 generally refers to an insole insert in accordance with the present invention, as shown in Figs. 2 through 7i. The insole insert 1 generally comprises a body member 7 having a contoured upper surface 13 for comfortable stable support of a wearer's foot, as indicated in Fig. 2, and a lower surface 15 for bearing against the insole of a wearer's shoe 17.

A perimeter 21 of the body member 7 substantially defines the limits of both the upper surface 13 and the lower surface 15, and includes regions defined for purposes of reference herein as a toe edge 23, a heel edge 25, a medial side edge 27, and a lateral side edge 29 corresponding to parts of the user's foot. The length and width of any particular one (or pair) of the insole insert 1 may vary as is customary, depending upon the size of footwear for which that insole insert 1 is intended, and the overall depth or thickness of any particular one (or pair) of the insole insert 1 may also vary considerably, depending on the style of footwear into which the insole insert 1 is to be inserted. Also, at certain specific sites on the insole insert 1, the depth may vary as hereinafter described.

Various dimensions are quantified here below for exemplary purposes only; those quantities were observed for an insole insert 1 of the present invention for a woman's size nine, oxford-type shoe, sometimes referred to herein as the "woman's size-nine exemplary specimen". It is to be understood that those dimensions may increase or decrease according to the shoe size or shoe type for which a particular set of the insole inserts 1 is to be utilized.

The body member 7 is constructed of a material having a selected compression resistance. For example, the material from which the body member 7 of the insole insert 1 is molded or otherwise formed is preferably a pliable vinyl or other synthetic substance, such as those sometimes referred to as EVA (ethylene vinyl alcohol), PVA (polyvinyl alcohol), PU (polyurethane) or latex foam, polypropylene, DPU, etc., or other readily moldable substance which yields a relatively soft, pliable form once

cured or "set". The material selected should be one that provides the desired cushioning, lightweightness, physical strength, wearability, rot resistance, slip resistance, is relatively durable with long use, and is preferably relatively inert to not commonly cause allergic reactions when in contact with skin. Preferably, the material selected is also one that may be trimmable with a pair of scissors or shears, if necessary, for more precisely adapting, or custom fitting, the insole insert 1 to the footwear for which it is intended.

The upper surface 13 may, if desired, be overlaid for style and/or comfort with a thin fabric layer or liner 33 or other suitable pliable sheet-like material, as shown in Figs. 3 through 6, to separate the sole of the wearer's foot from direct contact with the upper surface 13 of the underlying insert body member 7. For example, the liner 33 may be constructed of an elastomeric polymer cloth. In addition, the liner 33 may be made of an odor and/or moisture absorbing material, as known in the art, and may also be impregnated with an antibacterial and/or antimicrobial agent.

The insole insert 1 includes a bottom portion 37, a depression area 43, a heel portion 45, and an arch portion 47. The bottom portion 37 has a front or toe section 53, extending rearwardly from the toe edge 23 to a metatarsal neck support section 55 of the bottom portion 37, and a rear section 57 extending rearwardly alongside the metatarsal neck support section 55 to a rear portion 63 of the heel portion 45, as shown in Fig. 7 and as hereinafter described. The front section 53 has a generally uniform thickness, as indicated by the numeral 59 in Fig. 4. For example, the front section 53

of the woman's size-nine exemplary specimen of the insole insert 1 may have a uniform thickness of approximately four millimeters.

The depression area 43 is generally has a dished configuration and is perforation-modified as hereinafter described or otherwise configured to permit the user's first metatarsal-phalangeal joint J1 to move vertically downwardly and proximally while progressing through midstance to propulsive phases of the user's gait. The depression area 43, which is generally formed in the bottom portion 37 such that the user's first metatarsal-phalangeal heat M1 is spaced approximately centrally thereover, is configured to have sufficient horizontal and vertical dimensions to properly accommodate the user's paired sesamoid bones located beneath his first metatarsal joint J1 to thereby allow proper, natural flexion of the user's first metatarsal phalangeal joints despite the user's foot being confined to an article of footwear.

More specifically, the depression area 43 permits the first metatarsal phalangeal joint J1 to be displaced more naturally relative to the adjacent metatarsals to promote increased stability and greater balance to the extrinsic and intrinsic musculature of the foot and to minimize or eliminate the incidence of saddle joint deformity. The depression area 43 is also configured to basically cup the first metatarsal phalangeal head M1 to thereby essentially fix the support provided by the insole insert 1 securely in the footwear against the user's foot and, additionally, to prevent forward slippage of the user's foot in the footwear.

For example, the depression area 43 of the woman's size-nine exemplary specimen of the insole insert 1 has a depth of approximately 2 mm, a width of

approximately 3.5 cm or approximately forty percent of the overall width of the insole insert 1, and a fore-to-aft dimension of approximately 4.3 cm or approximately sixteen percent of the overall length of the insole insert 1.

It is to be understood that the depression area 43 may be shaped approximately circularly, rectangularly, triangularly, ovular, or any other suitable shape so long as the depression area 43 is properly dimensioned to, cooperatively with other components of the insole insert 1, accomplish desired foot functioning and redistribution of the weight-generated forces bearing against the sole of the user's foot during the various phases of the user's gait.

The heel portion 45 and the arch portion 47 are configured and dimensioned to cooperatively redistribute relatively large weight-generated forces bearing against certain areas of the sole of the user's foot, that are normally induced during various supported phases of the user's gait, to other areas of the user's foot that normally experience smaller weight-generated forces. To cooperatively assist with accomplishing such redistribution of weight-generated forces, the rear portion 63, a medial portion 64, and a lateral portion 65 of the heel portion 45 extend inwardly from the perimeter 21 such that the portion of the user's body weight supported by the user's heel is distributed over a substantially larger area. More specifically, weight-bearing forces normally bearing against the sole of the user's foot are shifted away from the more bony regions of the user's foot, such as the central region of the user's heel for example, toward the larger and more fleshy areas of the user's foot, such as the user's arch and the outer regions of the user's heel.

For example, the horizontal width of the heel portion 45 of the woman's size-nine exemplary specimen of the insole insert 1 at the rearmost extremity of the insole insert 1 may have a horizontal width in the range of approximately 1.0 cm, or approximately fifteen percent of the overall width of the insole insert 1 transversely through a center of curvature 67 as hereinafter described, and approximately four percent of the overall length of the insole insert 1.

Each of the rear portion 63, the medial portion 64, and the lateral portion 65 of the heel portion 45 has a generally triangular configuration where they extend above the rear section 57 of the bottom portion 37 such that the rear portion 63, the medial portion 64, and the lateral portion 65 gently arcuately taper downwardly and inwardly from the perimeter 21 to the rear section 57, as indicated by the numeral 71 in Figs. 7g and 7i, to thereby form a generally semi-circular boundary 73 about the center of curvature 67 between the heel portion 45 and the rear section 57. If desired, the inner edges of the rear portion 63, the medial portion 64, and the lateral portion 65 may be spaced slightly above the rear section 57 in order to form a relief, as indicated by the numeral 77 in Fig. 7h, to thereby facilitate minimal shifting of flesh of the sole of the user's foot to assist with accommodation of the redistribution of weight-generated forces from the rear section 57 to the heel portion 45 and the arch portion 47.

Further, the lateral portion 65 of the heel portion 45 extends forwardly along the lateral side edge 29 to terminate at a foremost end 83 thereof, as shown in Fig. 7. For example, the lateral portion 65 of the heel portion 45 of the woman's size-nine

exemplary specimen of the insole insert 1 generally extends forwardly to approximately fifty-five percent of the overall length of the insole insert 1.

For the variation shown in Figs. 8 through 11, the lateral portion 65 of the heel portion 45 extends forwardly along the lateral side edge 29 to terminate at the distal end of the calcaneus (calcaneal-cuboid joint). The example for the variation generally extends forwardly to approximately twenty-five percent of the overall length of the insole insert 1.

The arch portion 47 extends substantially above the rear section 57 of the bottom portion 37 and gently arcuately tapers downwardly and inwardly from the upper attached perimeter 17 to the rear section 57 and to grade into the metatarsal support section 55. The metatarsal support section 55 is adapted to underlie and support the second and third (and perhaps fourth, if desired) metatarsal necks. The metatarsal support section 55 is slightly elevated above the front section 53 and the rear section 57 to thereby form an extension of the boundary 73, which can be described as beginning approximately beneath and between the first and second metatarsal shafts of the user's foot, arcuately passing beneath the second through fourth metatarsal necks, continuing rearwardly and medially to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts, between the cuboid and the lateral cuneiform and navicular bones, to then continue alongside the medial portion 64, the rear portion 63, and the lateral portion 65 of the heel portion 45, as hereinbefore described.

The arch portion 47 generally grades into the metatarsal support 55 and extends forwardly from the medial portion 64 of the heel portion 45 along the medial side edge 27 to terminate just rearwardly of the depression area 43. In other words, the arch portion 47 extends forwardly to approximately sixty percent of the overall length of the insole insert 1. The underside of the arch portion 47 may be hollowed out, as indicated by the numeral 84 in Fig. 7d, to further promote lightweightness of the insole insert 1.

Similarly to the heel portion 45, the arch portion 47 extends inwardly from the perimeter 21, oppositely from the lateral portion 65 of the heel portion 45, such that only a relatively narrow corridor 85 of the bottom portion 37 remains available to provide comfort or cushioning to dampen stress for the corresponding regions of the user's foot to thereby, in conjunction with the lateral portion 65, the medial portion 64, and the rear portion 63 of the heel portion 45, redistribute the relatively larger weight-generated forces normally applied to the rear section 57 from the rear section 57 to the heel portion 45 and the arch portion 47. In other words, the heel portion 45, in conjunction with the arch portion 47, is configured to redistribute the weight-generated forces, among other things, from the center of the user's heel generally outwardly to thereby reduce or eliminate the incidence of bruising of the bottom center of the user's heel.

An example of the insole insert 1 in accordance with the present invention is shown in the series of cross-sectional views in Figs. 7a through 7h, as follows:

Fig. 7a, taken along line a-a of Fig. 7 distally from the depression area 43, shows the front portion 53 in cross-section, with the profile of the depression area 43 extending therebelow, and the profiles of the heel portion 45, the arch portion 47, and the metatarsal support section 55 extending thereabove;

Fig. 7b, taken along line b-b of Fig. 7 distally from the metatarsal support section 55, shows the depression area 43 and the bottom portion 37 in cross-section, with the profiles of the heel portion 45, the arch portion 47, and the metatarsal neck support section 55 extending thereabove;

Fig. 7c, taken along line c-c of Fig. 7 in a transition region between the depression area 43 and the arch portion 47, shows the bottom portion 37 including the metatarsal support section 55 in cross-section, with the profiles of the heel portion 45 and the arch portion 47 extending thereabove;

Fig. 7d, taken along line d-d of Fig. 7, shows the bottom portion 37 including the metatarsal support section 55 in cross-section, with the partially cross-sectioned profiles of the heel portion 45 and the arch portion 47 extending thereabove;

Fig. 7e, taken along line e-e of Fig. 7, shows the bottom portion 37 including the metatarsal support section 55 in cross-section, with the partially cross-sectioned profiles of the heel portion 45 and the arch portion 47 extending thereabove;

Fig. 7f, taken along line f-f of Fig. 7, shows the bottom portion 37 including the metatarsal support section 55 in cross-section, with the partially cross-sectioned profiles of the heel portion 45 and the arch portion 47 extending thereabove;

Fig. 7g, taken along g-g of Fig. 7, shows the bottom portion 37 in cross-section, with the partially cross-sectioned profile of the heel portion 45 extending thereabove;

Fig. 7h, taken along h-h of Fig. 7, shows the bottom portion 37 and the medial and lateral portions 64, 65 of the heel portion 45 in cross-section, with the profile of the rear portion 63 of the heel portion 45 extending thereabove; and

Fig. 7i, taken along i-i of Fig. 7, fragmentarily shows the bottom portion 37 including the metatarsal support section 55 and the rear portion 63 of the heel portion 46 in cross-section, with the profiles of the arch portion 47 and the medial portion 64 of the heal portion 46 extending thereabove.

Similar descriptions for Figs. 9, 9a through 9f, 10, and 11 should be obvious to those with skill in the art.

As an example of dimensions for the heel portion 45 and the arch portion 47 of the woman's size-nine exemplary specimen of the insole insert 1, the width of the corridor 83 at the center of curvature 78 thereof is approximately 3.2 cm; the horizontal width of the lateral portion 65 of the heel portion 45 and the height of the perimeter 21 above the rear section 57 transversely from the center of curvature 67 is

approximately 1.5 cm and 1.4 cm, respectively; the horizontal width of the rear portion 63 of the heel portion 45 and the height of the perimeter 21 above the rear section 57 directly rearwardly from the center of curvature 78 is approximately 1.3 cm and 1.3 cm, respectively; the horizontal width of the arch portion 47 and the height of the perimeter 21 above the rear section 57 transversely from the center of curvature 78 is approximately 1.8 cm and 1.5 cm, respectively; and the combined horizontal width of the metatarsal support section 55 and the arch portion 47 and the height of the perimeter 21 above the rear section 57 at the highest point of the arch portion 47 is approximately 4.1 cm and 2.0 cm, respectively.

The heel portion 45 and the arch portion 47 are cooperatively configured such that the body weight of the user is distributed over a larger area of the sole of the user's foot. Due to the configuration of the heel portion 45 and the arch portion 47 wherein the heel portion 45 and the arch portion 47 extend above the bottom portion 37, the user's foot is supported at an elevation slightly above the elevation at which it would otherwise be supported were it not for the configuration of the heel portion 45 and the arch portion 47. As a result, the larger weight-generated forces normally applied to the user's arch are redistributed toward areas of the user's arch that are normally subjected to much smaller weight-generated forces.

Further, the cooperative configuring of the heel portion 45 and the arch portion 47, wherein the user's foot is supported at a slightly higher elevation within footwear as hereinbefore described, in conjunction with the depression area 43, also redistribute the larger weight-generated forces normally applied to the user's

forefoot, such as the sesamoids and fifth metatarsal joint, toward areas of the user's forefoot that are normally subjected to much smaller weight-generated forces. As a result, the upward pull on the wearer's calcaneus normally experienced with prior art insoles is reduced by the insole insert 1 to thereby reduce the strain on the user's intrinsic or interior foot muscles and to reduce or eliminate the incidence of plantar fascial tears including the heel pain associated therewith.

The arch portion 47, in conjunction with the depression area 43, is configured to permit weight-generated forces to be more naturally distributed between the user's arch and the various metatarsals to thereby minimize or eliminate the incidence of tibial sesamoiditis. Further, the arch portion 47 and the depression area 43 are configured such that cooperative interaction therebetween reduces first ray instability by supporting the talonavicular joint which, in turn, reduces the stress on adjacent metatarsals thereby decreasing or eliminating the incidence of metatarsal stress fractures. Also, the arch portion 47 is configured to promote more natural control of the talonavicular joint to thereby decrease or eliminate the incidence of shin splints and fatigue of the front and back leg muscles, and to thereby promote more efficient movement of the user's lower leg muscles.

The structural and contour features of the upper surface 13, namely the depression area 43, the metatarsal support section 55 of the bottom portion 37, the heel portion 45, and the arch portion 47 are configured to cooperatively provide the insole insert 1 with the ability to permit a user's foot to be secure and stable as necessary for appropriate flexing and movement of the bone structure throughout the phases of gait

in most existing footwear that do not otherwise provide such security and stability. As an added benefit of the insole insert 1, the bottom portion 37, the depression area 43, the heel portion 45, and the arch portion 47 are configured such that cooperative interaction thereamong largely minimizes or eliminates excessive inward rotation of the user's leg to thereby reduce knee and hip discomforts sometimes associated therewith. Further, and particularly for users having flat feet, the bottom portion 37, the depression area 43, the heel portion 45, and the arch portion 47 are configured such that cooperative interaction thereamong will more naturally balance the extrinsic and intrinsic muscles on the top and bottom of the user's foot to thereby minimize or entirely eliminate the maladies commonly referred to as bunions and hammertoes.

The body member 7 of the insole insert 1 includes a perforation-modified portion 89 having throughbores or perforations 91 configured to provide the perforation-modified portion 89 with a selected effective compression resistance that is reduced from the inherent compression resistance of the material from which the body member 7 is constructed. The body member 7 also includes a non-perforation-modified portion 93 that does not include the perforations 91, and, therefore, exhibits the same compression resistance as the inherent compression resistance of the material from which the body member 7 is constructed.

To selectively provide the reduced compression resistance of the perforation-modified portion 89, the perforations 91 are punched or otherwise formed in the

perforation-modified portion 89. For example, as shown in Figs. 2 and 7, the perforation-modified portion 89 includes the front section 53 and the rear section 57 of the bottom portion 37 and the depression area 43 to thereby enhance the shock absorbing characteristics thereof. For example, in the woman's size-nine exemplary specimen, the perforations 91 have a diameter of approximately 1.5 mm. In should be understood, however, that the perforations 91 may have any other suitable cross-sectional dimension or dimensions.

If it should be desired to reduce the compression resistance in the perforation-modified portion 89 even farther, the perforations 91 may be spaced more closely together, as illustrated in the area enclosed by the dashed line designated by the numeral 95 in Fig. 7, or may have larger cross-section dimensions, or both. Similarly, if greater compression resistance is desired in another region of the insole insert 1, the perforations 91 are either spaced farther apart, have smaller diameters, or are non-existent, such as in the metatarsal support section 55 as shown in Figs. 2 and 7.

The body member 7 preferably has a Type C (commonly referred to as "Shore C Scale") durometer hardness or compression resistance measured in accordance with American Society of Testing and Material (ASTM) standard D 2440-97 of less than about 70 and more preferably a compression resistance in a range of about 40-60. Depending upon the particular activity for which the footwear is intended, however, the compression resistance may be greater or lesser as desired. For example, if the footwear is intended for walking, the body member

7 may have a Type C durometer hardness (ASTM D 2240-97) of about forty-five, whereas if the footwear is intended for running, the body member 7 may have a hardness of about sixty. In short, the body member 7 should be sufficiently "soft" to provide shock attenuation, but sufficiently firm to provide stability to the foot. Preferably, the arch portion 47 has a Type C durometer hardness (ASTM D 2240-97) of 50-85, and preferably greater than about sixty. For footwear (e.g. work boots) subjected to heavy loading, the body member 7 preferably has a hardness of about 75.

It is to be understood that the perforation-modified portion 89 may have some sections thereof having a selected effective compression resistance, due to a certain effective area density of the perforations 91, that is reduced from the inherent compression resistance of the material from which the body member 7 is constructed, and one or more other sections having different selected effective compression resistances corresponding to respective effective area densities of the perforations 91 therein. Simply stated, the greater the density of the perforations 91 in a given area, or the larger the ratio of the cross-sectional area of the perforations 91 to the total area of the corresponding perforation-modified portion 89, the softer the compression resistance provided in that region of the insole insert 1.

It is also to be understood that a certain component or components of the insole insert 1 may be included as part of the perforation-modified portion 89 in some applications, wherein one or more of those same components may be included as part of the non-perforation modified portion 93 in other applications.

When the insole insert 1 is unloaded, such as when the user is not placing weight thereon, the perforations 91 assume their original, generally cylindrical, shape, as shown in Fig. 5. However, when the user does apply weight to a given region of the insert insole 1 that comprises the perforations 91, such as the depression area 43 as shown in Fig. 6, the bulk of the material, comprising that given region and from which the insole insert 1 is constructed, is compressed but, in addition, the compressed material also expands into the associated perforations 91, thereby providing realization of the reduced compression resistance provided by the resiliency modification function of the perforations 91.

A state-of-the-art system, developed for measuring the distribution of weight-generated forces applied to the sole of a user's foot, sometimes referred to as "F-scan in-shoe gait analysis", was used to evaluate the inventive features of the insole insert 1 of the present invention. The F-scan system uses paper-thin insole devices, each approximately 0.007-inch thick and containing on the order of a thousand individual sensors. The F-scan insole devices are flexible and trimmable to custom fit almost any shoe size or shape, including children's shoes. During evaluations, the F-scan insoles are inserted into the footwear. The foot is placed into the shoe with or without a sock. The bi-pedal plantar pressures at each of the sensors are then detected, monitored, and recorded by the F-scan system as they sequentially occur during a normal gait cycle and/or during stance. The results may then be compared with similar measurements taken with the same or similar footwear, one

set with modifications such as the insole insert 1, and one set without such modifications.

In regard to the present invention, F-scan computerized gait analysis system was used for diagnostic evaluations of footwear not providing the benefits of the insole insert 1 and compared with corresponding diagnostic evaluations of footwear utilizing the insole insert 1 of the present invention. The comparison of the sets of analyses disclosed that the greatest weight-generated forces normally applied to localized regions of the user's foot were indeed redistributed toward other regions of the user's foot sole normally experiencing smaller weight-generated forces to thereby substantially reduce the range of applied weight-generated forces.

In an application of the present invention wherein the insole insert 1 is appropriately installed in existing footwear and worn on a user's foot, some of the primary benefits provided by the insole insert 1 while walking and running begin at heel strike, when the heel of the user's footwear first hits the underlying supporting surface. The compression resistance of the lateral portion 65 of the heel portion 45 of the insole insert 1, in addition to cooperatively redistributing weight-generated forces applied to the user's foot as described herein, also provides cushioning for those initial impacts to thereby reduce risk of injury to the user and to thereby support and promote enhanced efficiency of other associated parts of the user's foot and lower skeletal structure.

After each such initial impact, the user's foot pivots distally about his heel, with the lateral sides of his arch and forefoot impacting against the underlying supporting surface and his foot pronating to a neutral position with the central vertical plane of his heel generally appropriately oriented perpendicularly to the underlying supporting surface. Again, compression resistance of the arch portion 47 and the front section 53 of the bottom portion 37 of the insole insert 1 provides cushioning for the shocks arising from such secondary impacts. As the user's metatarsal shifts downwardly and proximally, the first metatarsal phalangeal joint stabilizes as it must before the user's foot subsequently lifts from the underlying supporting surface. The lesser metatarsal phalangeal joints are accordingly stabilized for dorsiflexion due to the contours of the insole insert 1 as herein described.

The compression resistance of the front section 53 of the bottom portion 37 beneath the user's metatarsal heads M1-M5 also serves to redistribute weight-generated forces thereagainst during mid-stance through propulsive phases of his gait cycle. The described motion places the user's foot in an appropriate biomechanical position for the propulsive phase of his gait cycle, including proper displacing of his sesamoid apparatus during mid-stance and toe-off phases. In addition, the cooperative interaction by the heel portion 45 and the arch portion 47, whereby the user's foot is fully supported slightly above the elevation that the user's foot would otherwise be supported were it not for the heel portion 45 and the arch portion 47, allows the sesamoids and certain muscles of the user's foot to

momentarily rest to thereby create a desirable timing sequence thereof and, cooperatively with the depression area 43, to create a more effective lever system just prior to the foot progressing into the toe-off phase of his gait.

As the user's foot rotates forwardly into the toe-off phase, the first metatarsal MI is permitted by the insole insert 1 to be appropriately pushed downwardly, remaining stable as the user's heel lifts from the underlying supporting surface, and continuing to remain stable and appropriately flex without forward slippage up to the position in the user's gait whereat the first metatarsal phalangeal joint J1 lifts from the underlying supporting surface. In other words, as the user's heel lifts from the underlying supporting surface, the insole insert 1 allows the user's first metatarsal phalangeal joint J1 to actually displace downwardly to continue to be stabilized, thereby progressively providing appropriate functioning of the user's foot throughout the entire supported phases of his gait.

One of the primary reasons the user's foot remains stable throughout the supported phases of his gait is because the structure of the insole insert 1 provides support and stability for each of the user's heel, arch, and first metatarsal from before the user's foot rotates forwardly, whereat his heel would lift from the underlying supporting surface, to the point in the user's gait whereat the user's first metatarsal actually lifts from the underlying supporting surface. Thus, the insole insert 1 appropriately provides all of the necessary supporting and stabilizing factors. By providing the inventive structure in one, unitary insole insert, the user's foot can function appropriately within the confines of his shoe.

In other words, the insole insert 1 is adapted to support and maintain the heel in a perpendicular orientation relative to the underlying supporting surface, to thereby support the longitudinal arch of the foot by shifting the weight laterally, to provide a larger surface area to balance pedal weight as well as to provide a more even distribution of weight-generated forces applied to the sole of his feet, and to allow his foot to function more efficiently by allowing the first metatarsal phalangeal joint J1 and associated sesamoid apparatus to function properly.

It should now be obvious from the foregoing that the material properties of the various regions of the insole insert 1 appropriately cushion, support and stabilize the various parts of the user's foot as herein described. It should also now be obvious that the compression resistances hereinbefore described may be selectively altered, depending upon the intended use of the footwear for which the insole insert 1 is intended. For example, adult footwear designed for use in situations where the wearer will frequently be carrying a heavy load (e.g., work boots) may require more support and greater compression resistance than a child's dress shoe. Likewise, footwear made for running may require firmer support in the heel section to thereby absorb the greater initial shock of each running step than would a hiking boot in which more cushioning, or reduced compression resistance, may be desired for each walking step. Further, it will be appreciated that the present invention is not limited necessarily to any particular type of footwear and may be equally desirable for use in shoes, boots and sandals. In addition, it should be understood that the locations of the areas of softer, or lesser compression resistance, material

relative to other areas of harder, or greater compression resistance, material may be selectively altered without departing from the scope of this invention.

Use of the insole insert 1 of the present invention in infant's footwear will preferably be initiated as soon as the infant's feet become weight-bearing to thereby aid the child in standing and walking, to mold the child's foot into an appropriate position that does not interfere with the foot's normal ontogenetic development, and to provide substantially full and complete support between the child's foot and the underlying supporting surface.

In accordance with the present invention, the arch portion 47 and the body member 7 of the insole insert 1 are cooperatively dimensioned and configured such that (i) the perforation-modified portion 89 generally includes the central region of the user's heel; a lateral region along the user's arch; and the user's forefoot and toe regions; and (ii) the non-perforation modified portion 93 generally includes a medial region of the user's arch; and lateral, rear, and medial regions of the user's heel.

The perforation-modified portion 89 of the body member 7 compresses relatively easily when loaded; however, the non-perforation-modified portion 93 of the arch portion 47 does not compress as easily when loaded. Therefore, the perforation-modified portion 89 of the body member 7 is configured to, among other things, compress more easily to absorb impact forces, whereas the non-perforation-modified portion 93 of the arch portion 47 is configured to, among other things, more diligently resist compression and thereby provide firmer support for the associated regions of the user's foot.

Stated another way, the arch portion 47 firmly supports the osseous alignment of the user's foot when in the neutral position thereby relieving stress in the ligaments, muscles and tendons which maintain the foot in this position. During the transition from the neutral position to toe-off, the metatarsal support section 55 provides needed support for the second and third (and perhaps fourth, N4) metatarsal necks N2, N3, but the depression area 43 of the perforation-modified portion 89 of the body member 7 permits the first metatarsal head M1 to plantarflex relative to the second and third metatarsal heads M2, M3.

It is to be understood that the invention described herein is not to be limited to footwear for children but, in many cases, may be equally applicable to insole inserts for adult footwear and that, while certain forms of the present invention have been illustrated and described herein, it is not to be limited to the specific forms or arrangement of parts described and shown.

CLAIMS

What is claimed and desired to be secured by Letters Patent is as follows:

1. An insole insert for a user's footwear, comprising a unitary body member constructed of material having a selected material compression resistance, said body member including:
   (a) a perforation-modified portion having perforations configured to provide said perforation-modified portion with a selected effective compression resistance with a magnitude that is less than the magnitude of said material compression resistance; and
   (b) a non-perforation-modified portion not having said perforations.

2. The insole insert of claim 1, including a depression area formed in said body member and spaced generally beneath a first metatarsal phalangeal joint of the user.

3. The insole insert of claim 2, wherein said perforation-modified portion includes said depression area.

4. The insole insert of claim 2, wherein said depression area has a concave configuration.

5. The insole insert of claim 1, wherein said body member includes a toe edge and a toe portion extending rearwardly from said toe edge to terminate generally distally from the second and third metatarsal phalangeal joints of the user's foot.

6. The insole insert of claim 5, wherein said body member includes a metatarsal support portion extending rearwardly from said toe portion alongside said arch portion forming a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's first through fourth metatarsal necks, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones.

7. The insole insert of claim 6, wherein said non-perforation-modified portion includes said metatarsal support portion.

8. The insole insert of claim 6, wherein said non-perforation-modified portion includes said metatarsal support portion, a perimeter of said heel portion and said arch portion to thereby provide supporting and controlling portions of the insole insert.

9. The insole insert of claim 6, further including a relief situated along said boundary.

10. The insole insert of claim 5, wherein said perforation-modified portion includes said toe portion.

11. The insole insert of claim 10, wherein said perforation-modified portion further includes said depression area of said heel and the first metatarsal head, the fifth metatarsal head, shaft and base, and cuboid portions of said supporting body member.

12. The insole insert of claim 1, wherein said body member includes:

(a) a bottom portion, a heel edge, a lateral side edge, and a medial side edge;

(b) a heel portion formed along said heel edge, said lateral side edge, and said medial side edge of said body member; and

(c) an arch portion formed along said medial side edge and extending forwardly from said heel portion; and

(d) wherein said body member, said depression area, said heel portion, and said arch portion are configured to cooperatively redistribute weight-generated forces operatively bearing against the sole of the user's foot such that greater weight-generated forces normally bearing against certain regions of the heel and forefoot of the user's foot are

substantially reduced and redistributed toward other regions of the sole of the user's foot during supported phases of the user's gait.

13. The insole insert of claim 12, wherein said body member also includes a metatarsal support portion extending rearwardly from said toe portion alongside said arch portion forming a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's first through fourth metatarsal necks, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones.

14. The insole insert of claim 13, wherein said perforation-modified portion includes said bottom portion to the extent that said bottom portion is spaced between said arch portion, said heel portion, and said metatarsal support portion.

15. The insole insert of claim 12, wherein said non-perforation-modified portion includes said heel portion.

16. The insole insert of claim 12, wherein said non-perforation-modified portion includes said arch portion.

17. The insole insert of claim 12, wherein said heel portion generally extends above said bottom portion, transversely from said center of curvature, approximately eight to ten percent of the transverse width of said channel at said center of curvature.

18. The insole insert of claim 1, wherein said arch portion extends forwardly to a foremost portion thereof spaced just rearwardly of said depression portion.

19. The insole insert of claim 1, wherein said arch portion extends forwardly to approximately fifty-five to sixty percent of the overall length of said insole insert.

20. The insole insert of claim 1, wherein said heel portion extends forwardly to a foremost end thereof spaced just rearwardly of the user's fifth metatarsal base.

21. The insole insert of claim 1, wherein said heel portion extends forwardly to a foremost end thereof spaced approximately below the calcaneal-cuboid joint.

22. An insole insert for a user's footwear, comprising:

(a) a unitary body member constructed of material having a selected material compression resistance, said body member including a toe edge, a heel edge, a lateral side edge, and a medial side edge; said body member including:

(1) a bottom portion, including a toe portion extending rearwardly from said toe edge to terminate generally distally from the second and third metatarsal phalangeal joints of the user's foot,

(2) a heel portion formed along said heel edge, said lateral side edge, and said medial side edge of said body member; said heel portion having a lateral portion extending forwardly to a foremost end thereof spaced just rearwardly of the user's fifth metatarsal phalangeal joint,

(3) an arch portion formed along said medial side edge and extending forwardly from said heel portion to a foremost end,

(4) a metatarsal support portion extending rearwardly from said toe portion and alongside said arch portion, said metatarsal support portion having a boundary beginning approximately beneath the juncture between the user's first and second metatarsal phalangeal joints, arcuately passing approximately beneath the user's second through fourth proximal phalanges, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal necks and the

juncture between the cuboid bone and the lateral cuneiform and navicular bones of the user's foot, and

(5) a relief formed along said boundary; and

(b) a depression area formed in said body member, having a concave configuration, and spaced generally beneath a first metatarsal phalangeal joint of the user such that said depression area is spaced just distally of said foremost end of said arch portion; and

(c) perforations selectively formed in said body member to provide said body member with:

(1) at least one perforation-modified portion having a selected effective compression resistance with a magnitude that is less than the magnitude of said material compression resistance, said perforation-modified portion including said depression area, said toe portion, and said bottom portion to the extent that said bottom portion is spaced between said arch portion, said heel portion, and said metatarsal support portion, and

(2) a non-perforation-modified portion not having said perforations, said non-perforation-modified portion including said metatarsal support portion, said heel portion, and said arch portion; and

(d) wherein said body member, said depression area, said heel portion, and said arch portion are configured to cooperatively redistribute weight-generated forces operatively bearing against the sole of the

user's foot such that greater weight-generated forces normally bearing against certain regions of the sole of the user's foot are substantially reduced and redistributed toward other regions of the sole of the user's foot during supported phases of the user's gait.

23. An insole insert for a user's footwear, comprising:

(a) a unitary body member constructed of material having a selected material compression resistance, said body member including a toe edge, a heel edge, a lateral side edge, and a medial side edge; said body member including:

(1) a bottom portion, including a toe portion extending rearwardly from said toe edge to terminate generally distally from the first through fourth metatarsal phalangeal necks of the user's foot,

(2) a heel portion formed along said heel edge, said lateral side edge, and said medial side edge of said body member; said heel portion having a lateral portion extending forwardly to a foremost end thereof spaced just rearwardly of the user's calcaneal-cuboid joint,

(3) an arch portion formed along said medial side edge and extending forwardly from said heel portion to a foremost end,

(4) a metatarsal support portion extending rearwardly from said first metatarsal neck and alongside said arch portion, said

metatarsal support portion having a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's first through fourth metatarsal necks, and passing beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones, and

(5) a relief formed along said boundary; and

(b) a depression area formed in said body member, having a concave configuration, and spaced generally beneath a first metatarsal phalangeal joint of the user such that said depression area is spaced just distally of said foremost end of said arch portion; and

(c) perforations selectively formed in said body member to provide said body member with:

(1) at least one perforation-modified portion having a selected effective compression resistance with a magnitude that is less than the magnitude of said material compression resistance, said perforation-modified portion including said depression area, said first metatarsal head portion, and said bottom portion to the extent that said bottom portion is spaced between said arch portion, said heel portion, and said metatarsal support portion, and

(2) a non-perforation-modified portion not having said perforations, said non-perforation-modified portion including said metatarsal support portion, said heel portion, and said arch portion; and

(d) wherein said body member, said depression area, said heel portion, and said arch portion are configured to cooperatively redistribute weight-generated forces operatively bearing against the sole of the user's foot such that greater weight-generated forces normally bearing against certain regions of the sole of the user's foot are substantially reduced and redistributed toward other regions of the sole of the user's foot during supported phases of the user's gait.

24. The insole insert of claim 5, wherein said body member includes a metatarsal support portion extending rearwardly from said toe portion alongside said arch portion forming a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's second through fourth proximal phalanges, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones.

25. The insole insert of claim 12, wherein said body member also includes a metatarsal support portion extending rearwardly from said toe portion

alongside said arch portion forming a boundary beginning approximately beneath the juncture between the user's first and second metatarsal shafts, arcuately passing approximately beneath the user's second through fourth proximal phalanges, and continuing rearwardly to pass approximately beneath the juncture between the fourth and fifth metatarsal shafts and the juncture between the cuboid and the lateral cuneiform and navicular bones.

26. The insole insert of claim 1, wherein said heel portion extends forwardly to a foremost end thereof spaced just rearwardly of the user's fifth metatarsal phalangeal joint.

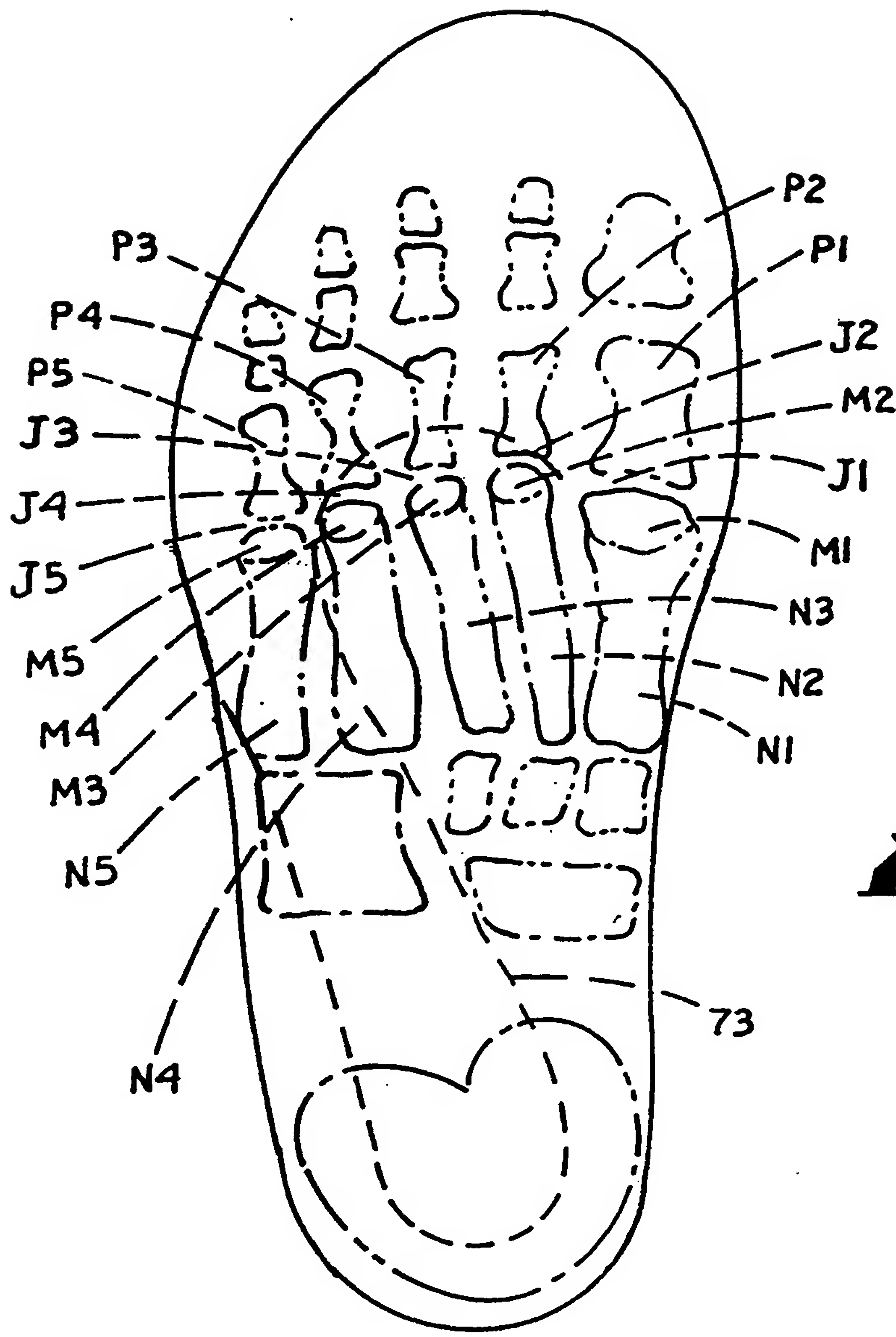


Fig.1.

Fig.2.

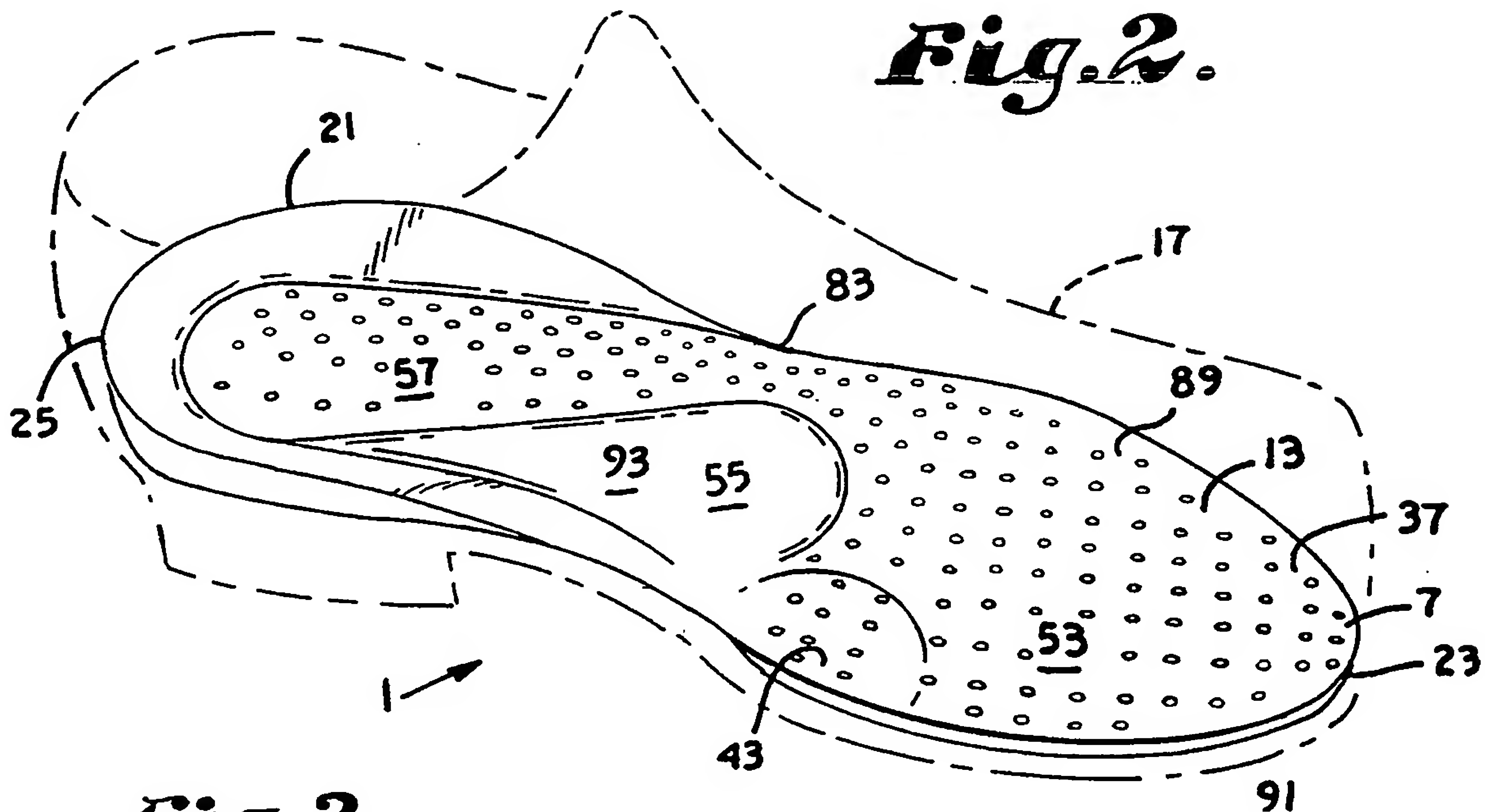
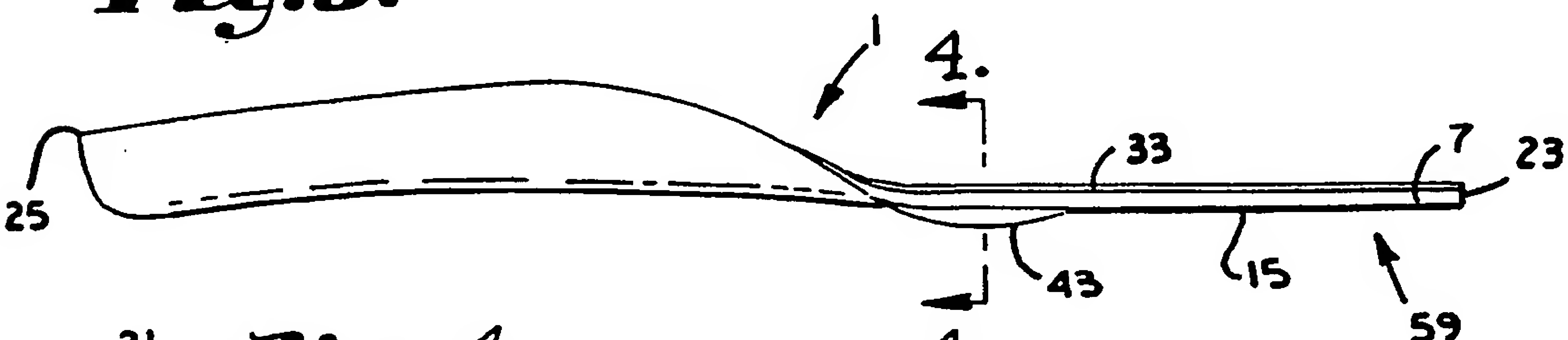


Fig.3.



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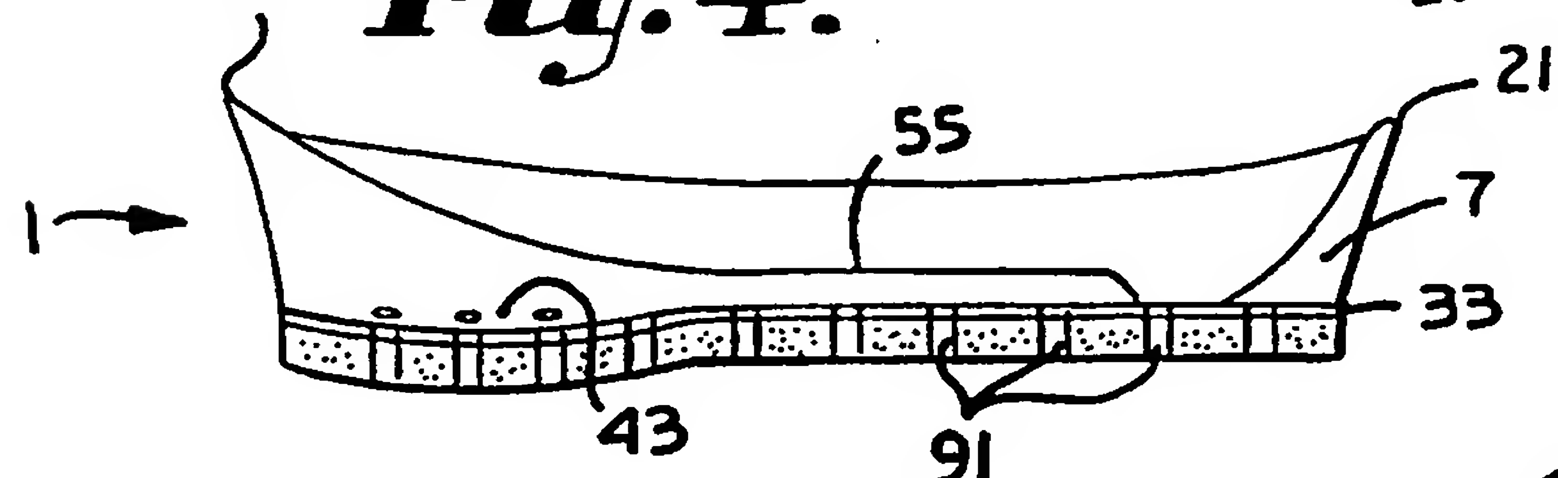

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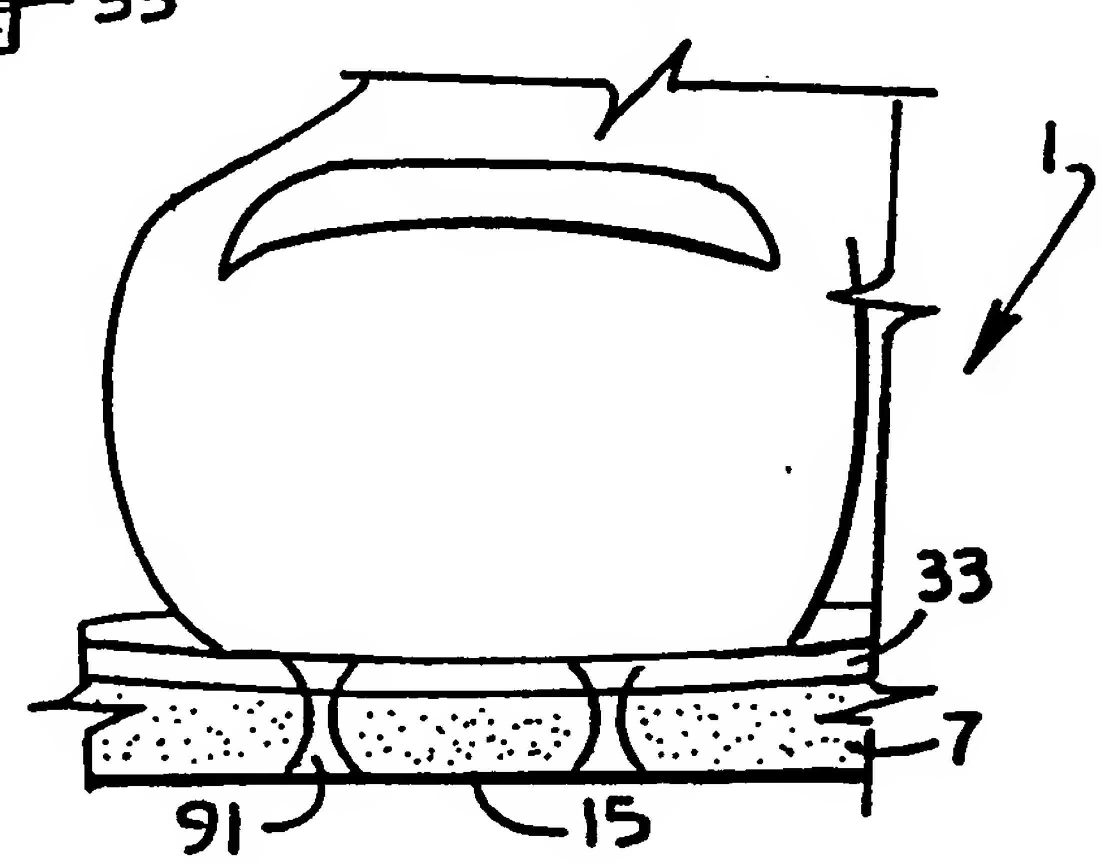

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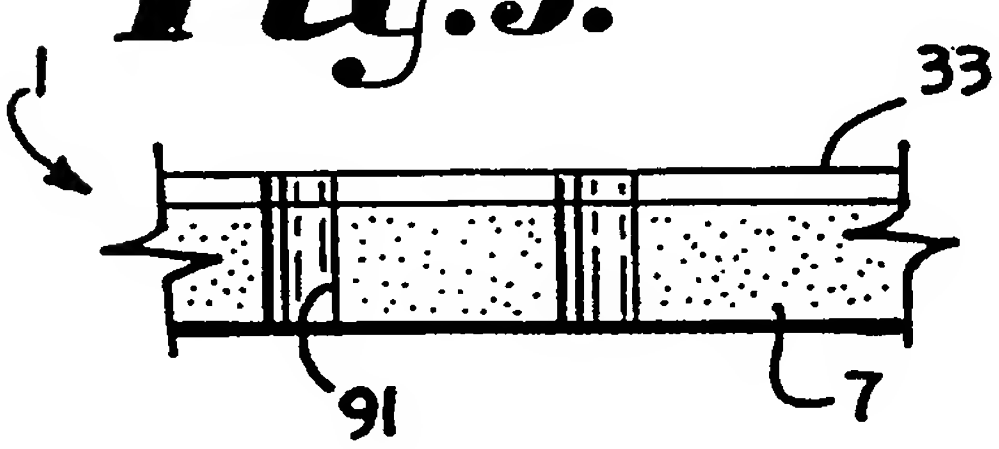
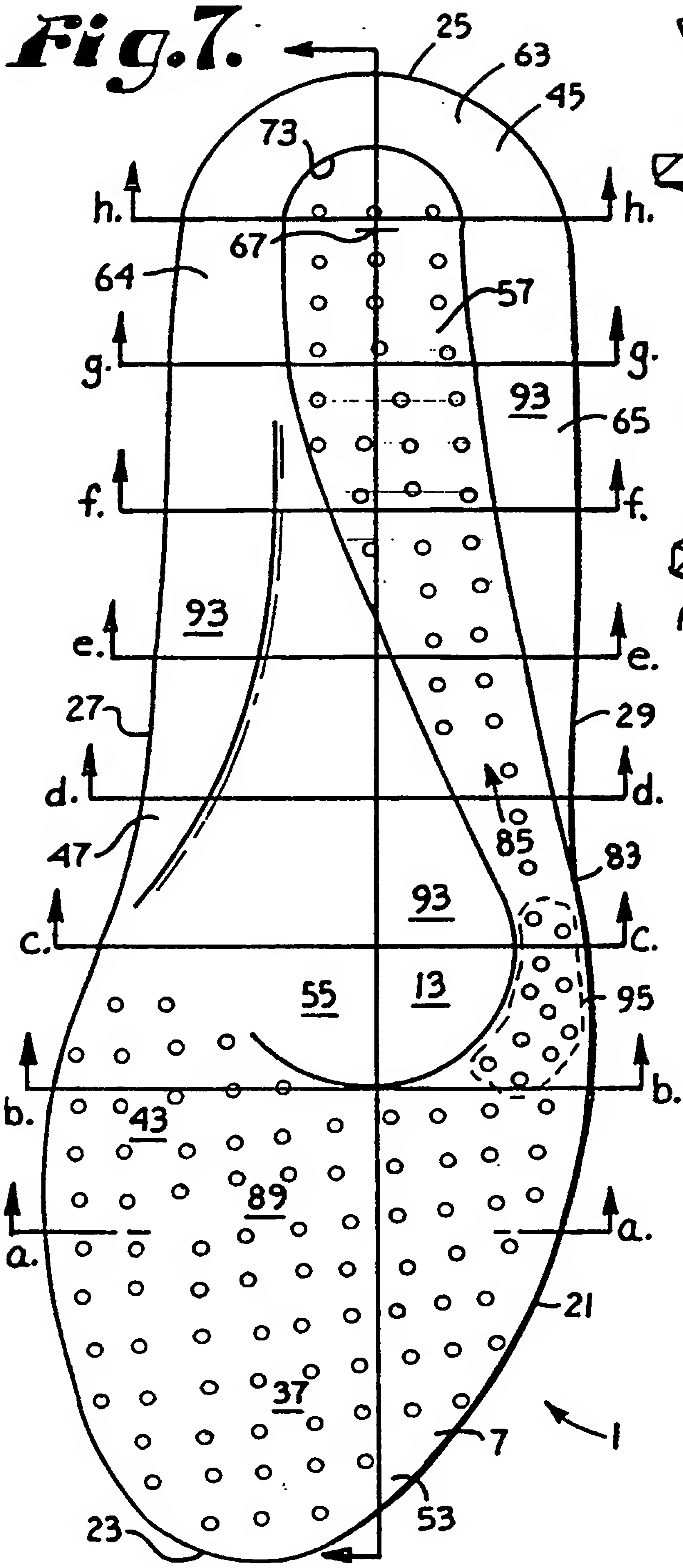


Fig.7.



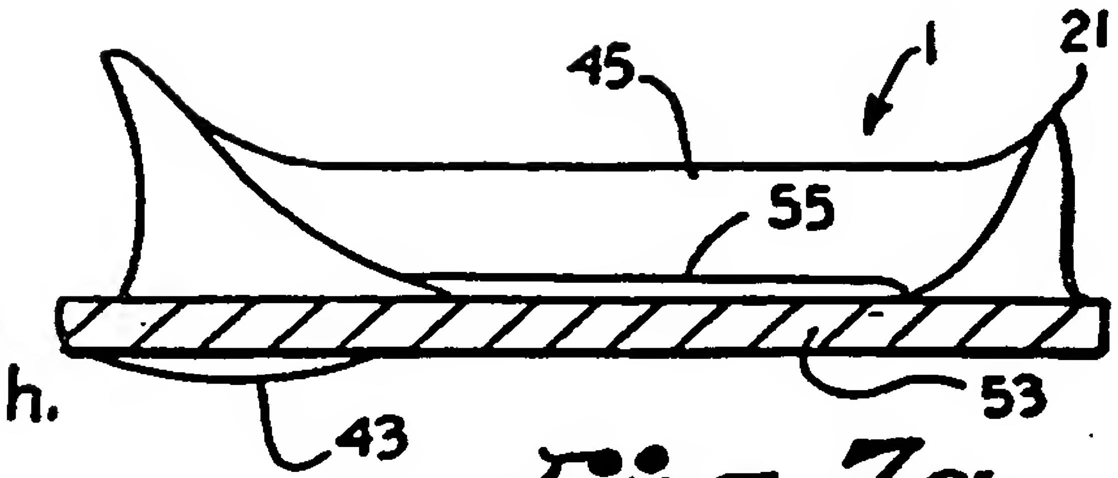


Fig.7a.

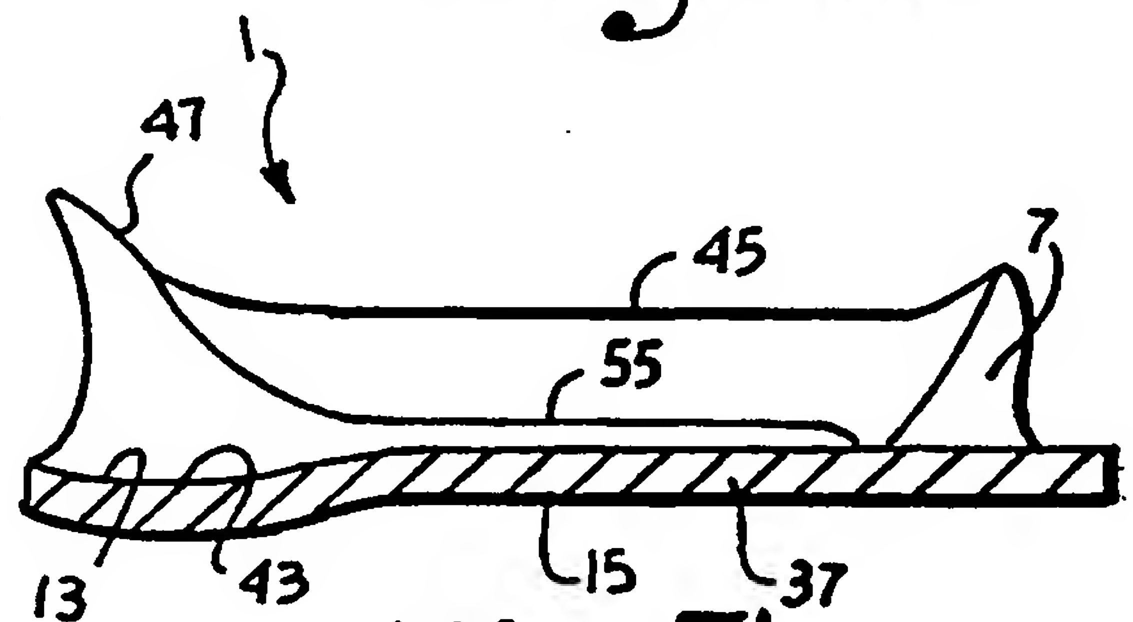
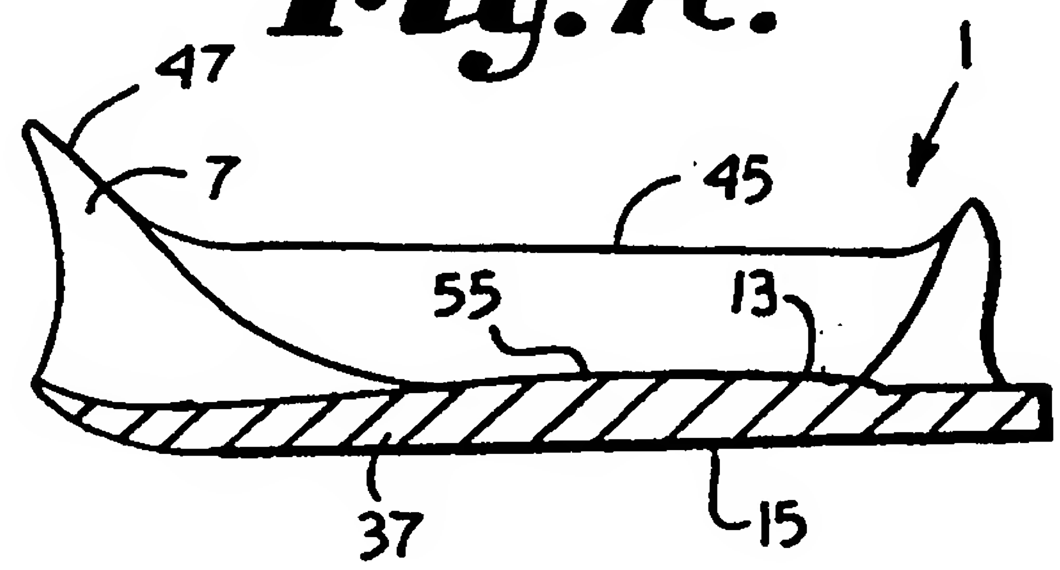


Fig.7b.

Fig.7c.



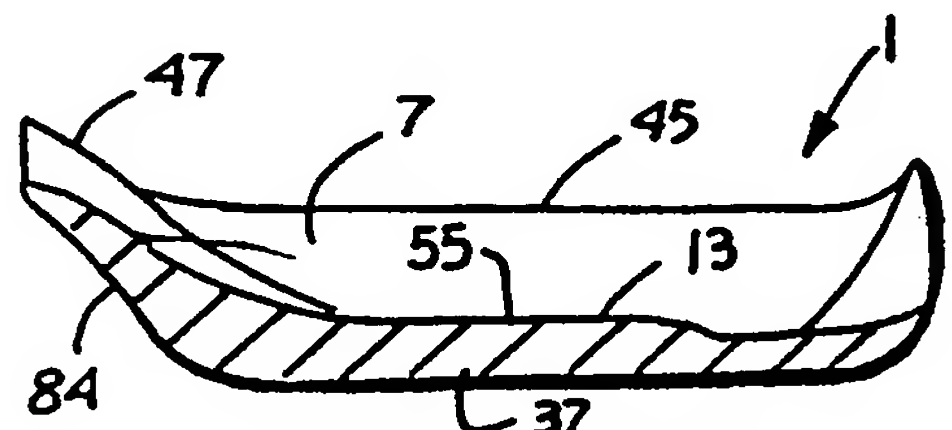


Fig.7d.

Fig.7e.

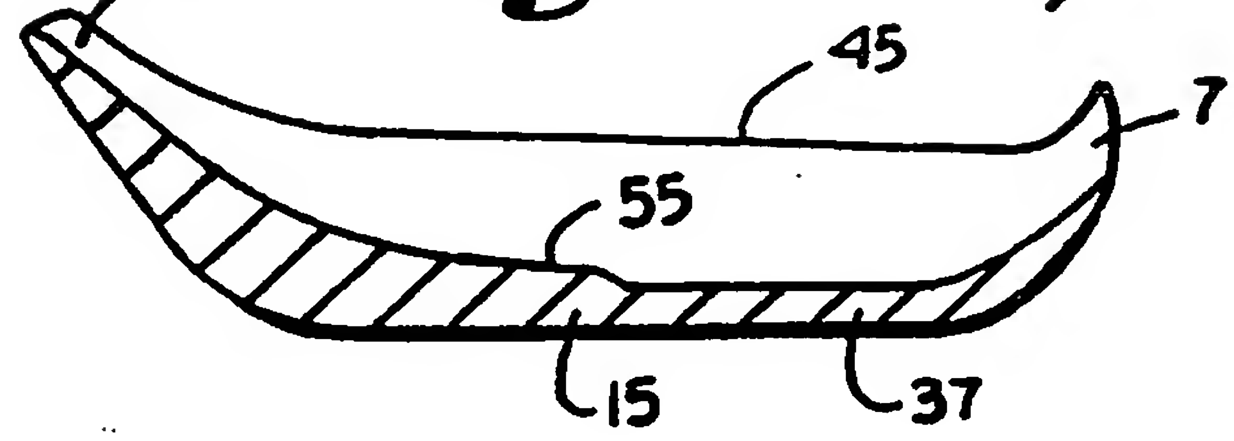
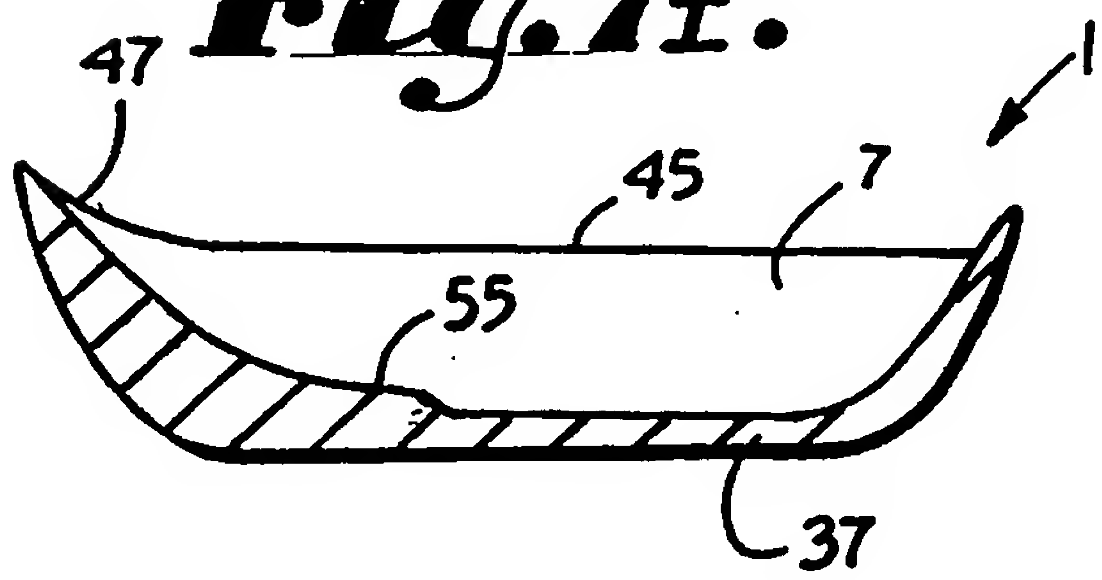


Fig.7f.



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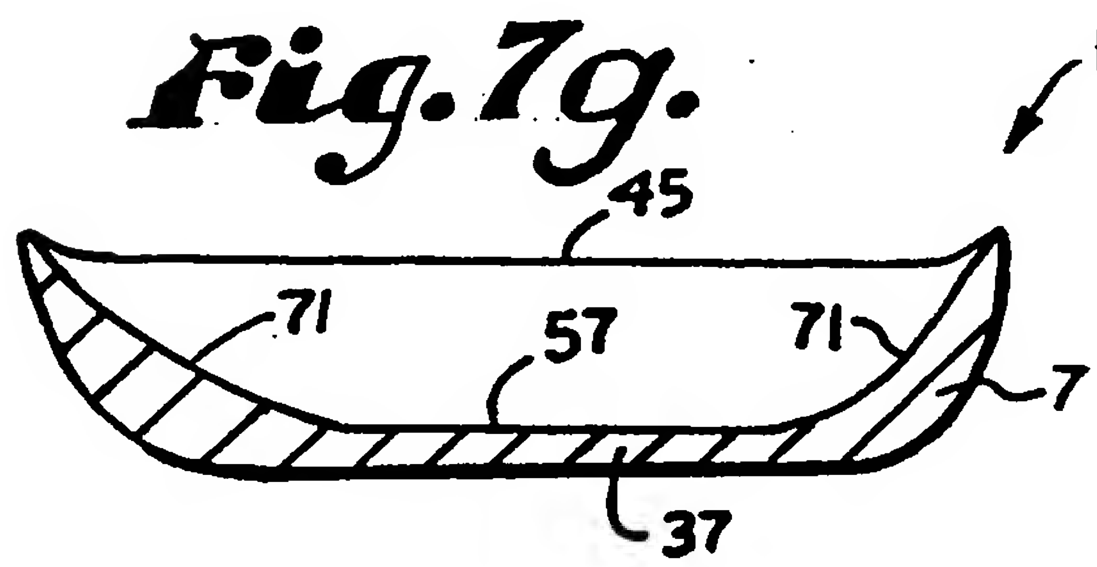

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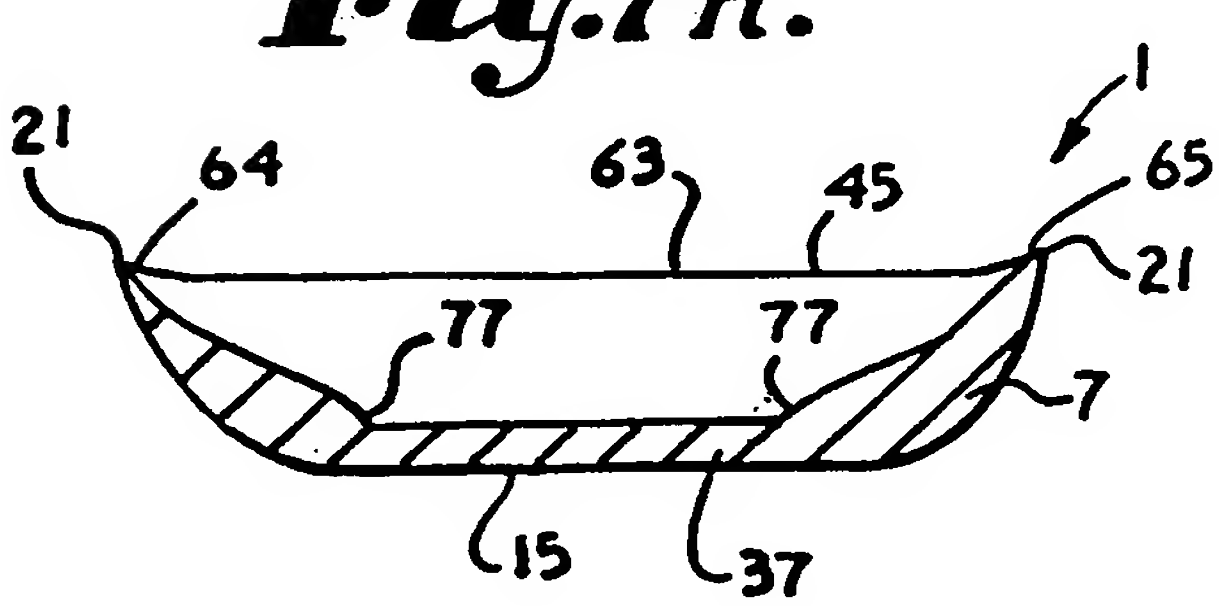
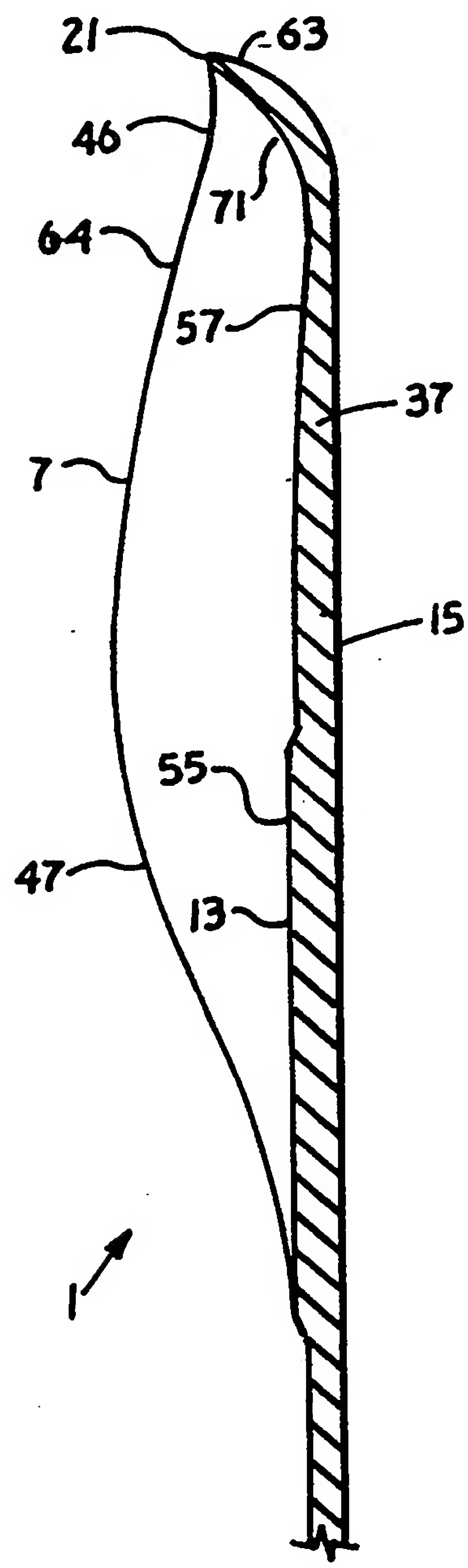


Fig.7i.



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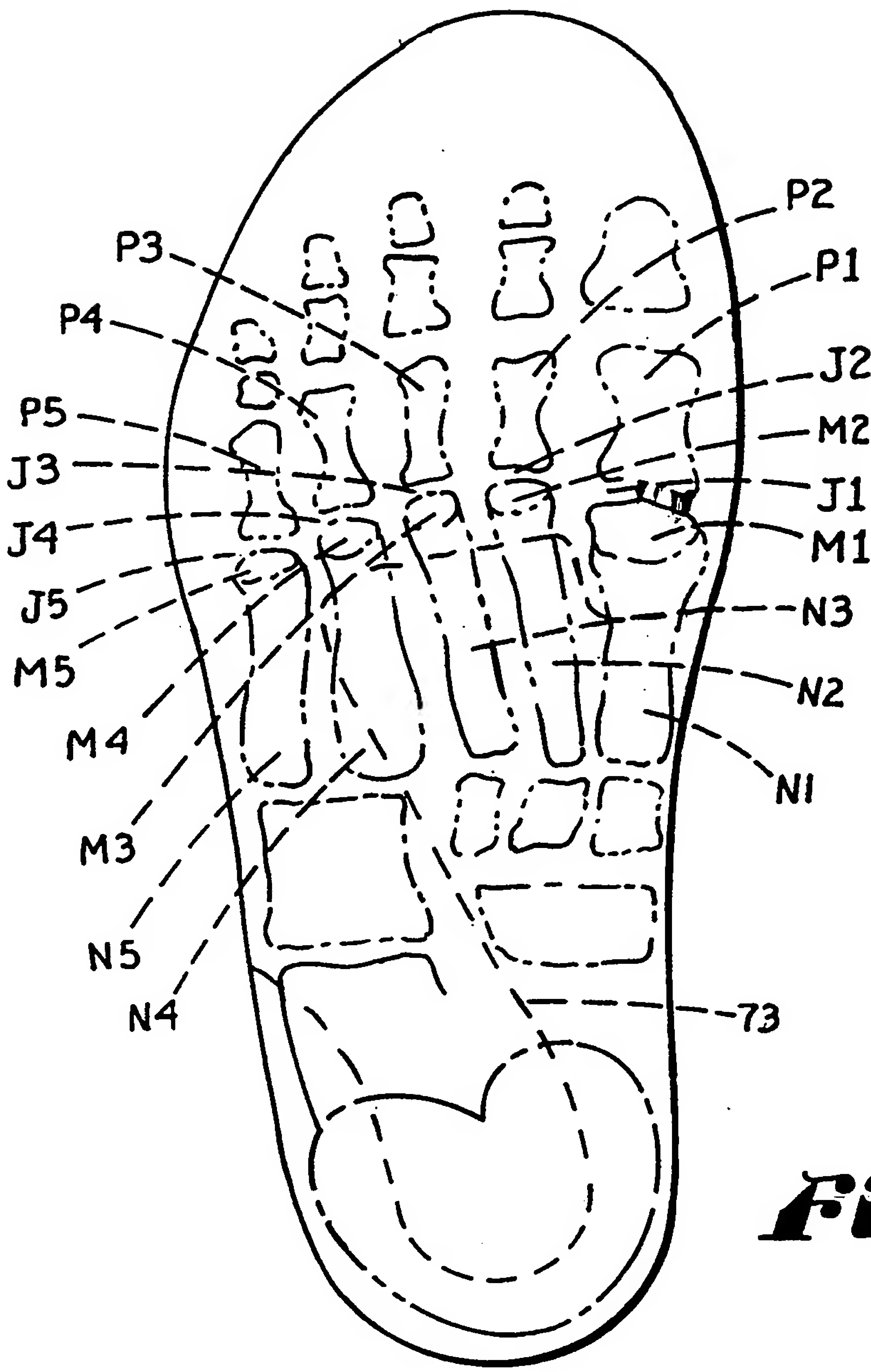


Fig.8.

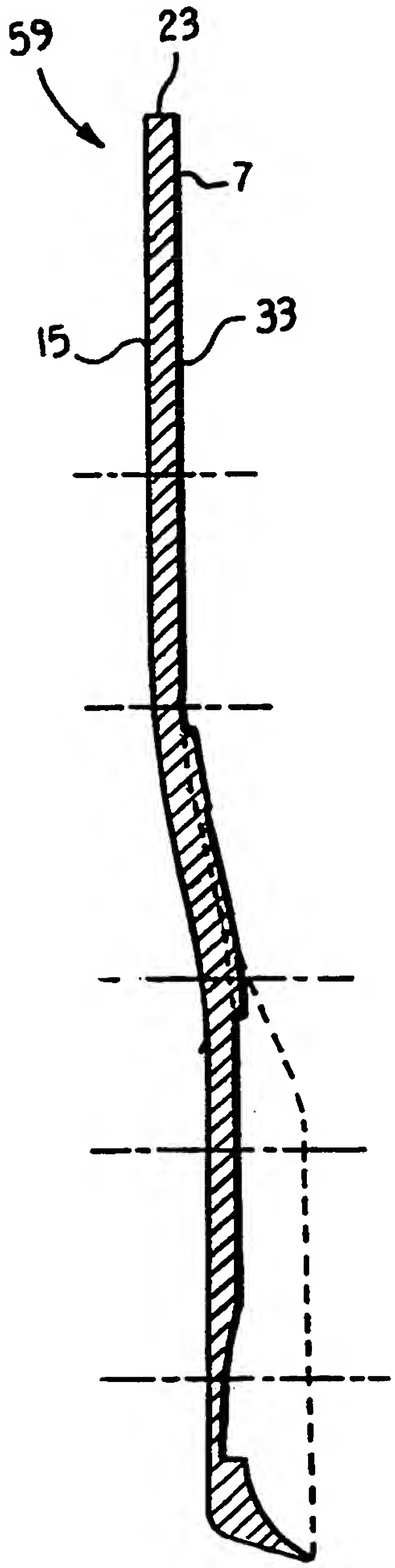


Fig. 9a.

Fig. 9b.

Fig. 9c.

Fig. 9d.

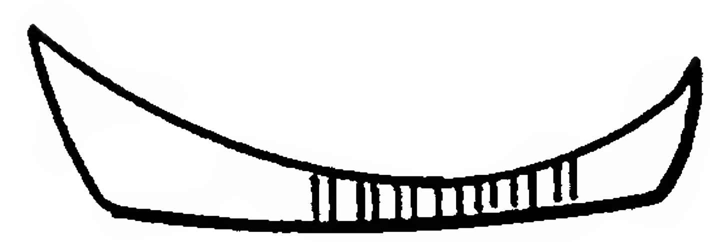


Fig. 9e.

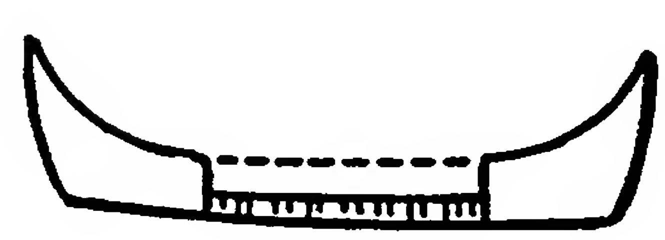
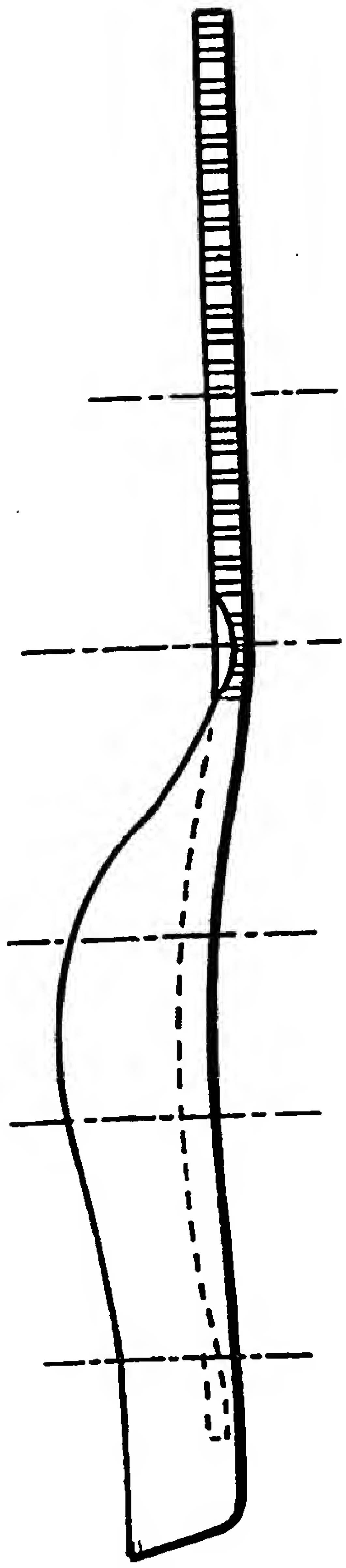


Fig. 9f.



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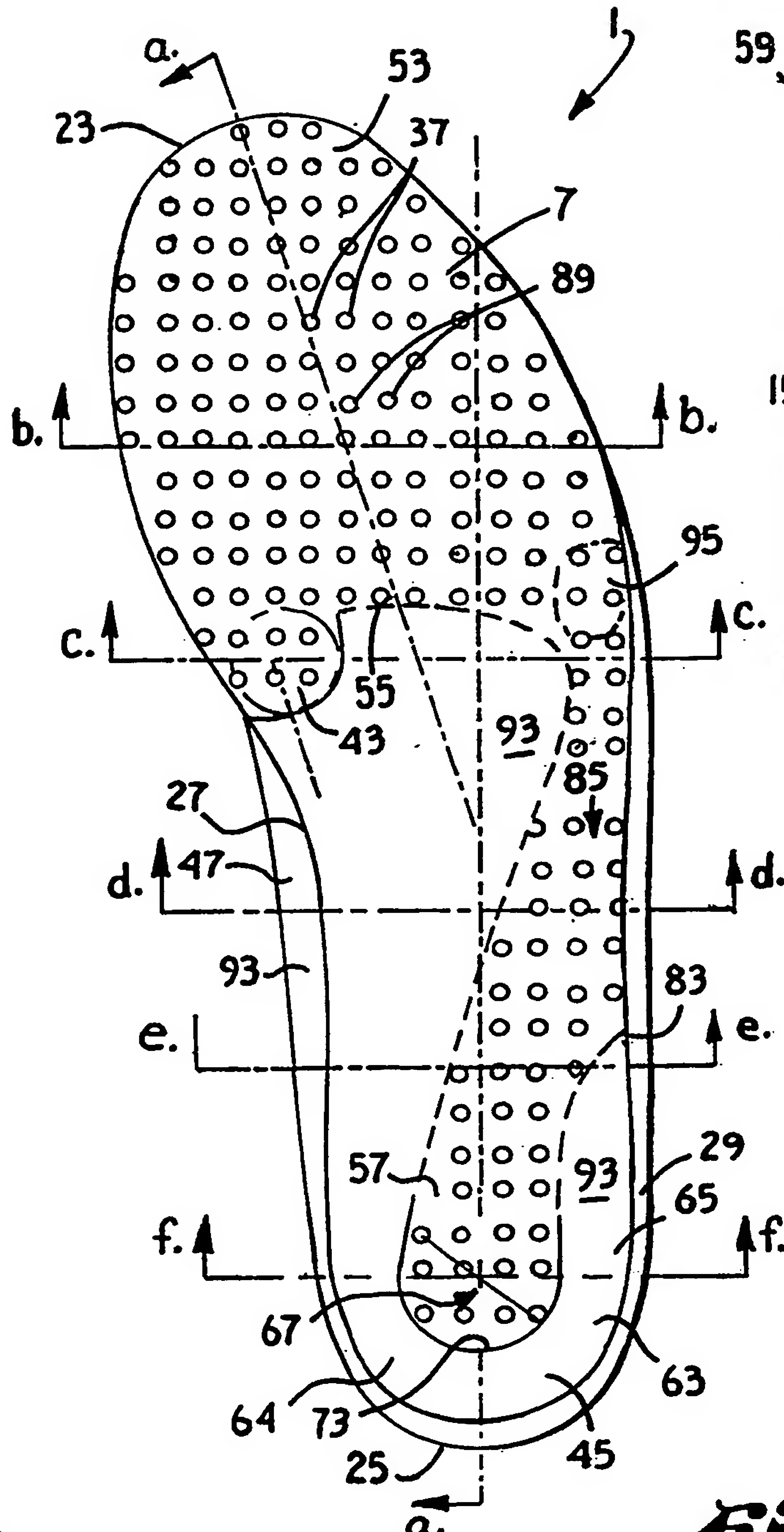

Fig.9.

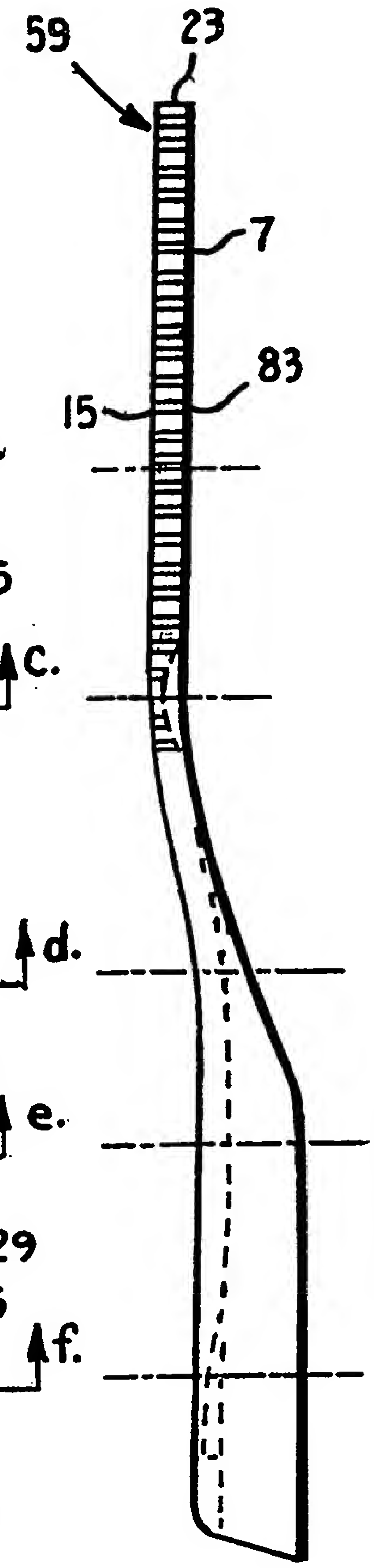

Fig.11.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/08534

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A43B 7/06, 7/08, 13/14
US CL :36/43, 142, 143, 144, 147, 174, 180, 3 R
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 36/43, 142, 143, 144, 147, 174, 180, 3 R, 44, 145, 166, 173, 181, 91, 92

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,611,153 A (fischer et al.) 18 March 1997, Whole document	1-26
X	WO 84/00481 (David) 16 February 1984, Figures 1 and 3, whole document	1-9, 11-15, 17, 18, 20-26
X	FR 2625-655 A (David) 13 July 1989, Abstract, Figures, whole document	1-9, 11-15, 17-18, 20-26
Y	US 2,917,849 A (Scholl) 22 December 1959, Figures 1 and 2, whole document	11, 14

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 MAY 1999	02 JUN 1999

Name and mailing address of the ISA/US	Authorized officer
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